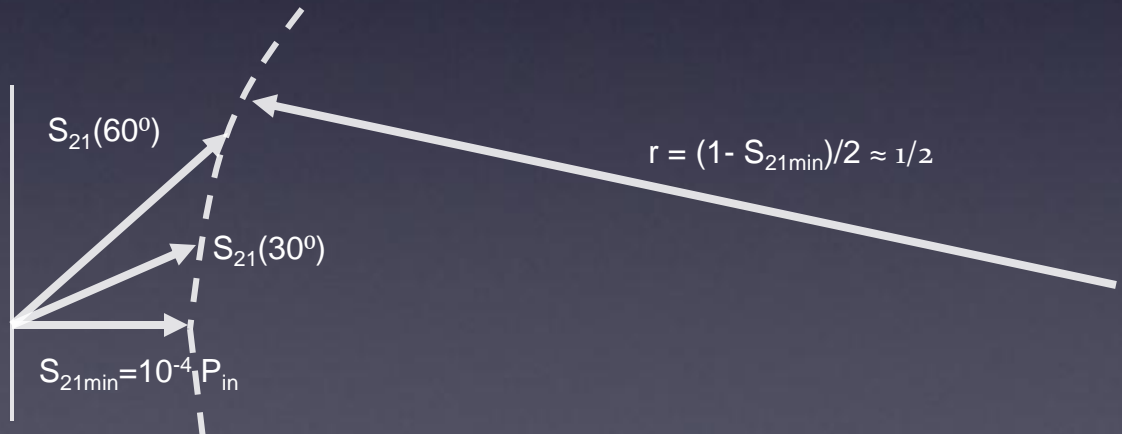


# Some signal to noise calculations

- Signal:
- $S_{21\min}=0.01$
- $P_{\text{in}}$  (the maximum power Nino claims to put in his MKIDs) = 10 pW (i.e.  $10^{-8}$  dBm)
- $P_{\text{out\_min}} = S_{21\min}^2 P_{\text{in}} = 0.001 \text{ pW} = 1 \text{ fW}$  (on resonance)
- Suppose the foton dynamic range maps into a 30 to 60 degree change of MKID's phase.
- That implies a Pout dynamic range between 0.5 and 0.866  $P_{\text{out\_min}}$ .
- That is  $0.35 P_{\text{out\_min}} = 0.35 \text{ fW}$ .
- If we want an R of 100, we need to be able to discriminate  $\Delta P_{\text{out}}(R=100) = 0.0035 P_{\text{out\_min}} = 0.0035 \text{ fW}$ .



# Some signal to noise calculations

- HEMT Noise:
- The HEMT noise between 4 GHz and 8 GHz is  $\sim 5$  K.
- $P_n = K_b T BW$  ( $K_b = 1.38 \cdot 10^{-23}$  and BW is the bandwidth per MKID channel, say 2 MHz)
- $P_n = 1.38 \cdot 10^{-23} * 5 * 2 \cdot 10^6 = 0.138$  fW
- If the noise is only white Gaussian, integrated over 100us is reduced by  $\sim 600$  times.
- $P_{n\_filtered} = 0.00023$  fW.

Signal to noise:  $\Delta P_{out}(R=100) / P_{n\_filtered} \sim 10$

